

09-28-00

A

ASSISTANT COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, DC 20231

PATENT  
Date: September 27, 2000  
File No. 0941.64787

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): Akira Tsuneya, Masato Nitta

For: APPARATUS AND METHOD FOR  
MANAGING NETWORK AND COMPUTER-  
READABLE RECORDING MEDIUM THEREOF

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Asst. Comm. for Patents, Washington, D.C. 20231, on this date.

9-27-00  
Date

Express Mail Label No.: EL409506475US

Enclosed are:

- (X) 34 pages of specification, including 18 claims and an abstract.
- (X) an executed oath or declaration, with power of attorney.
- ( ) an unexecuted oath or declaration, with power of attorney.
- ( )        sheet(s) of informal drawing(s).
- (X) 12 sheet(s) of formal drawings(s).
- (X) Assignment(s) of the invention to FUJITSU LIMITED.
- (X) Assignment Form Cover Sheet.
- (X) A check in the amount of \$ 40.00 to cover the fee for recording the assignment(s) is enclosed.
- ( ) Information Disclosure Statement.
- ( ) Form PTO-1449 and cited references.
- ( ) Associate power of attorney.
- (X) Priority Document.

Fee Calculation For Claims As Filed

a) Basic Fee						\$ 690.00
b) Independent Claims	<u>3</u>	-	3	=	<u>0</u>	x \$ 78.00 = \$ <u>      </u>
c) Total Claims	<u>18</u>	-	20	=	<u>0</u>	x \$ 18.00 = \$ <u>      </u>
d) Fee for Multiple Claims						\$260.00 = \$ <u>      </u>
Total Filing Fee						\$ <u>690.00</u>

(X) A check in the amount of \$ 690.00 to cover the filing fee is enclosed.

(X) The Commissioner is hereby authorized to charge any additional fees which may be required to this application under 37 C.F.R. §§1.16-1.17, or credit any overpayment, to Deposit Account No. 07-2069. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 07-2069. A duplicate copy of this sheet is enclosed.

Suite 8660 - Sears Tower  
233 S. Wacker Drive  
Chicago, Illinois 60606  
(312) 993-0080

GREER, BURNS & CRAIN, LTD.

By: [Signature]  
Patrick G. Burns  
Registration No. 29,367

09/27/00  
jc860 U.S. PTO

jc931 U.S. PTO  
09/27/00  
09/671008

09/27/00 09/671008

ASSISTANT COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, DC 20231

PATENT  
Date: September 27, 2000  
File No. 0941.64787

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): Akira Tsuneya, Masato Nitta

For: APPARATUS AND METHOD FOR  
MANAGING NETWORK AND COMPUTER-  
READABLE RECORDING MEDIUM THEREOF

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Asst. Comm. for Patents, Washington, D.C. 20231, on this date.

9-27-00  
Date

Express Mail Label No.: EL409506475US

Enclosed are:

- (X) 34 pages of specification, including 18 claims and an abstract.
- (X) an executed oath or declaration, with power of attorney.
- ( ) an unexecuted oath or declaration, with power of attorney.
- ( )        sheet(s) of informal drawing(s).
- (X) 12 sheet(s) of formal drawings(s).
- (X) Assignment(s) of the invention to FUJITSU LIMITED.
- (X) Assignment Form Cover Sheet.
- (X) A check in the amount of \$ 40.00 to cover the fee for recording the assignment(s) is enclosed.
- ( ) Information Disclosure Statement.
- ( ) Form PTO-1449 and cited references.
- ( ) Associate power of attorney.
- (X) Priority Document.


Fee Calculation For Claims As Filed

a) Basic Fee						\$ 690.00
b) Independent Claims	<u>3</u>	-	3	=	<u>0</u>	x \$ 78.00 = \$ <u>      </u>
c) Total Claims	<u>18</u>	-	20	=	<u>0</u>	x \$ 18.00 = \$ <u>      </u>
d) Fee for Multiple Claims						\$260.00 = \$ <u>      </u>
					Total Filing Fee	\$ <u>690.00</u>

- (X) A check in the amount of \$ 690.00 to cover the filing fee is enclosed.
- (X) The Commissioner is hereby authorized to charge any additional fees which may be required to this application under 37 C.F.R. §§1.16-1.17, or credit any overpayment, to Deposit Account No. 07-2069. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 07-2069. A duplicate copy of this sheet is enclosed.

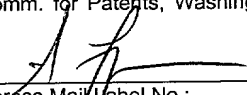
Suite 8660 - Sears Tower  
233 S. Wacker Drive  
Chicago, Illinois 60606  
(312) 993-0080

GREER, BURNS & CRAIN, LTD.

By:   
Patrick G. Burns  
Registration No. 29,367

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Asst. Comm. for Patents, Washington, D.C. 20231, on this date.

9-27-00  
Date

  
Express Mail Label No.:  
EL409506475US

# SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT WE, Akira Tsuneya, a citizen of Japan residing at Kawasaki, Japan and Masato Nitta, a citizen of Japan residing at Kawasaki, Japan have invented certain new and useful improvements in

APPARATUS AND METHOD FOR MANAGING NETWORK  
AND COMPUTER-READABLE RECORDING MEDIUM THEREOF

of which the following is a specification : -

002260-80042960

TITLE OF THE INVENTION

APPARATUS AND METHOD FOR MANAGING NETWORK  
AND COMPUTER-READABLE RECORDING MEDIUM THEREOF

5 BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to  
apparatuses for managing a network, methods for  
managing the network and computer-readable recording  
10 media having a program recorded thereon for causing a  
computer to manage the network, and more particularly  
to an apparatus for managing a network, a method for  
managing the network and a computer-readable  
recording medium having a program recorded thereon  
15 for causing a computer that monitor devices connected  
to the network to manage the network.

2. Description of the Related Art

Conventionally, in order to handle  
problems of a distributed system, an agent, which is  
20 a program for monitoring computers and network  
devices (such as a router, a hub or the like) that  
are connected to a network, is provided to each  
device in the network. A management server collects  
configuration information from each agent and display  
25 a map based on the configuration information. The  
management server receives a problem event, such as a  
SNMP (Simple Network Management Protocol) trap, sent  
by the agent when a problem has occurred. Then, the  
management server blinks an icon indicating the  
30 configuration information corresponding to the device  
where the problem event occurred, so as to notify an  
administrator of the problem with that device.

Thus, in a case in which a plurality of  
devices (routers, hubs, computers, and the like) are  
35 connected to a network, a problem occurring at a  
single device may influence other devices. As a  
result, an icon indicating by the configuration

09674008-092700

information corresponding to each of the other devices ends up blinking. This makes it difficult to distinguish which device originally caused the problem. Since special knowledge is required to  
5 specify which device originally caused the problem, it is difficult to immediately deal with the problem.

Further, the network structure and connected devices (routers, hubs, computers, and the like) to be managed may change. It is desired to  
10 recognize this change and automatically specify a problem device.

#### SUMMARY OF THE INVENTION

It is a general object of the present  
15 invention to provide an apparatus for managing a network, a method for managing the network and a computer-readable recording medium having a program recorded thereon for causing a computer to manage the network in which the above-mentioned problems are  
20 eliminated.

A more specific object of the present invention is to provide an apparatus for managing a network, a method for managing the network and a computer-readable recording medium having a program  
25 recorded thereon for causing a computer to manage the network, which can notify an administrator of a device actually causing a problem in the network.

The above objects of the present invention are achieved by an apparatus for monitoring devices  
30 connected to a network, including: a relationship object maintaining part maintaining dependent information for each relationship between devices connected to the network, the dependent information indicating how one device influences another device  
35 when the one device causes a problem; an event table maintaining part maintaining device information, which identifies a device in the network, indicated

09671008-092700

by an event received from the device; an event  
collecting part collecting each event received from  
the devices and controlling the event table  
maintaining part to maintain the device information  
5 when the event indicates a problem; and a problem  
alarm notifying part determining, based on the  
dependent information maintained by the relationship  
object maintaining part, whether or not each of the  
devices identified by the device information  
10 maintained by the event table maintaining part  
influences another device by the problem, and  
specifying which device is causing the problem in  
accordance with a result of the determination.

According to the present invention, the  
15 device that actually causes a problem can be  
specified and it is possible to inform the  
administrator which device causes the problem.

The above objects of the present invention are achieved by a method for managing a network, including the steps of: (a) maintaining dependent information for each relationship between devices connected to the network, the dependent information indicating how one device influences another device when the one device causes a problem; (b) maintaining device information, which identifies a device in the network, indicated by an event received from the device; (c) collecting each event received from the devices and executing the step (b) to maintain the device information when the event indicates a problem; and (d) determining, based on the dependent information maintained in the step (a), whether or not each of the devices identified by the device information maintained in the step (b) influences another device by the problem, and specifying which device is causing the problem in accordance with a result of the determination.

According to the present invention, it is

possible to provide the method for managing a network in that the device that actually causes a problem can be specified and it is possible to properly inform the administrator which device causes the problem.

5           The above objects of the present invention are achieved by a computer-readable recording medium having a program recorded thereon for causing a computer to manage a network, including the codes of:  
10       (a) maintaining dependent information for each relationship between devices connected to the network, the dependent information indicating how one device influences another device when the one device causes a problem; (b) maintaining device information, which identifies a device in the network, indicated by an  
15       event received from the device; (c) collecting each event received from the devices and executing the code (b) to maintain the device information when the event indicates a problem; and (d) determining, based on the dependent information maintained by the code  
20       (a), whether or not each of the devices identified by the device information maintained by the code (b) influences another device by the problem, and specifying which device is causing the problem in accordance with a result of the determination.

25           According to the present invention, it is possible for the computer that installed the program from computer-readable recording medium to specify the device actually causing a problem and properly inform the administrator which device causes the  
30       problem.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will become more apparent from  
35       the following detailed description when read in conjunction with the accompanying drawings, in which:

FIG.1 is a diagram of a system





apparatus for managing a network according to the present invention will now be described with reference to FIG.1 through FIG.12.

FIG.1 is a diagram of a system  
5 configuration according to an embodiment of the present invention.

In FIG.1, a server 1, as an apparatus for managing a network according to the present invention, monitors routers, hubs, and machines connected to  
10 network as devices to be managed and includes a relationship information generating part 2, a configuration information collecting part 3, an event correlating part 4, an event collecting part 5 and a relationship information generating rule 6.

15 The server 1 loads programs stored in a recording medium (not shown in FIG.1) in to a main memory such as a RAM and then executes the program concerning each process described later.

The relationship information generating  
20 part 2 is used to generate relationship information between the devices to be managed (for example, routers, hubs and machines). The relationship information generating part 2 further stores the relationship information as a relationship object 9  
25 of an object database (object DB).

The configuration information collecting part 3 collects configuration information of the devices to be managed that are connected to the network and further registers the collected  
30 configuration information as a the management object 8 of an object database (object DB).

The event correlating part 4 is used to check and select a relationship between events. That is, the event correlating part 4 refers to the  
35 relationship object 9 corresponding to each event sent from agents 21 shown in FIG.2 under management control, and checks and selects the relationship

002200-002200

between the events.

The event collecting part 5 is used to collect the events from the agents 21 managing the devices.

5           The relationship information generating rule 6 is a rule for automatically generating relationship information between the devices to be managed (Refer to FIG.8).

10           The object DB 7 is used to register and manage objects. That is, the object DB 7 registers and manages the management objects 8 and the relationship objects 9.

15           The management object 8 is used to register and manage the configuration information of each device to be managed (Refer to FIG.10A and FIG.10B).

            The relationship object 9 is used to register relationship information between the devices to be managed (Refer to FIG.10C).

20           An event table 10 stores events received from the agents 21 managing the devices (Refer to FIG.11 and FIG.12).           Operations of the server 1 will be now described.

25           The event collecting part 5 receives and collects the events sent from the agents 21 shown in FIG.2. The event correlating part 4 refers to a dependent relationship stored in the relationship object 9 and distinguishes a problem event indicating that a device is actually causing a problem.

30           Thereafter, the event correlating part 4 outputs the problem event (for example, an icon representing the device is blinked at a display unit to indicate where the problem is occurring).

35           When the server 1 is notified that a device to be managed is changed or additionally provided, information in the management object 8 is changed or information of the additional device is

004260-80074960



002260"092700

A small display window positioned at a lower left side is a sub-display window for indicating a dependent relationship between the devices to be managed. In this case, when the hub 12 indicated by a letter (a) and the machine 13 indicated by a letter (b) are clicked and selected by a user, the hub 12 and the machine 13 are displayed as a left icon and a right icon, respectively, in the sub-display window as indicated by dotted lines from the main display window. The user selects any one of the following settings for "INFLUENCE ON THE LEFT DEVICE WHEN A PROBLEM OCCURS AT THE RIGHT DEVICE" at an upper part of the sub-display window:

- CRITICAL
- 15       • LESS CRITICAL
- NO INFLUENCE

In this case, it is assumed that "NO INFLUENCE" is selected. Similarly, the user selects any one of the following settings for "INFLUENCE ON THE LEFT DEVICE WHEN A PROBLEM OCCURS AT THE RIGHT DEVICE" at a lower part of the sub-display window:

- CRITICAL
- LESS CRITICAL
- NO INFLUENCE

25 In this case, it is assumed that "CRITICAL" is selected. Information selected as shown in the sub-display window is registered as a hub-machine instance (the relationship object 8) as shown in FIG.10C described later. By this selection, an arrow (c) indicated by a solid line from the hub 12 to the machine 13 is displayed in the main display window in FIG.2.

As described above, the icons representing the devices connected to the network and being managed can be displayed on the main display window based on the configuration information of the management object 8. Moreover, the sub-display

35

window can be displayed by selecting two icons for the devices being managed and displayed in order to define the dependent relationship between the two devices. By indicating the dependent relationship (defined as any one of "CRITICAL", "LESS CRITICAL" and "NO INFLUENCE") between two devices, the indicated dependent relationship is registered in the relationship object 9 and can be displayed on the main display window by a directed arrow.

It should be noted that each agent 21 in FIG.2 is a program that is provided in each device to be managed and sends an event indicating a problem occurrence to the server 1.

FIG.3 is a diagram for explaining objects according to the present invention. In FIG.3, a status is shown in which the management objects 8 and the relationship objects 9 are registered for the devices shown on the left side of the main display window in FIG.2. Dotted squares show the management objects 8 and the relationship objects 9 automatically generated when a hub 14 and a machine 15 in FIG.2 are additionally provided.

As described above, the configuration information of each of the devices connected to the network to be managed (routers, hubs, machines and the like) is registered as a management object 8. Therefore, as shown in the left side of FIG.2, it is possible to display each device to be managed in a hierarchical structure and each dependent relationship showing a dependent direction by an arrow. Further, when additional devices to be managed are provided, additional management objects 8 and relationship objects 9 are generated. Then the hub 14, the machine 15, the arrow showing the dependent relationship between the hub 12 and the hub 14, and the arrow showing the dependent relationship between the hub 14 and the machine 15 in FIG.2 are



- CRITICAL
- LESS CRITICAL
- NO INFLUENCE

- CRITICAL
- LESS CRITICAL
- NO INFLUENCE

In a step S7, an instance for a hub-

As described above, after the relating selected from the process menu, devices to (for example, the hub 12 indicated by the and the machine 13 indicated by the letter lected to define a relationship. Then, play window in FIG.2 is displayed. Thus, nt relationships can be selected on the window (in this case, "CRITICAL" and "NO are selected for "INFLUENCE ON LEFT DEVICE M OCCURRED AT RIGHT DEVICE" and

FIG.5 is a flowchart for explaining a rule

5           In a step S11 of FIG.5, a rule for adding  
a node is executed.

In a step S13, it is checked whether or not the same MAC address is found. In this case, it is determined that the same MAC address is found (YES) since the hub 14 has the same MAC address as the machine 15. In a step S14, an instance of a hub-machine class (the relationship object 9 described later in FIG.10C) is automatically generated in accordance with steps S21 through S24.

30           In a step S22, an object ID=03 for a  
machine is substituted for an object ID2. That is,  
the object ID=03 for the machine 15 as a child in  
FIG.2 is input in a column of the object ID2 (child)  
of the relationship object 9 in FIG.10C so that the  
35   object ID=03 is registered.

In a step S23, "CRITICAL" is substituted for a dependence 1->2. That is, in accordance with a



5 "CRITICAL" is input in a column of the dependence 1-  
>2 so that a dependent relationship from the hub 14  
as a parent to the machine 15 as a child in FIG.2 is  
"CRITICAL".

As described above, when devices to be managed (routers, hubs, machines or the like) are additionally provided, in accordance with a corresponding rule (for example, when a machine is additionally connected to a hub, the rule in FIG.8 described later is used), it is possible to automatically create a relationship object 9 for registering a dependent relationship between the additional device and another device to be managed.

In a step S31 of FIG.6, a management object 8 for registering a device detected in another process is created. That is, for example, the process creates a management object 8 (such as a management object 8 in FIG.10A or FIG.10B) indicating that the configuration information of a device to be managed, which device is additionally provided and

detected in the network, is registered.

In a step S32, additional information is received. That is, the process receives additional information (such as a MAC address and the like)  
5 necessary for creating a relationship object 9 from the agent 21 arranged for monitoring the devices.

In a step S33, a class is distinguished. That is, the process distinguishes a class for the detected device and another device creating the  
10 dependent relationship.

In a step S34, a rule is searched for. That is, the process searches for a rule applying to the class distinguished in the step S33. For example, a rule in FIG.8 applying to the class for a hub and a  
15 machine is retrieved.

In a step S35, the rule is executed. That is, a relationship object 9 is automatically created by the rule applying to the class, which rule was found in the step S34. For example, the relationship  
20 object 9 shown in FIG.10C is created in accordance with the rule in FIG.8. Then, the steps S34 and S35 are repeated to complete all relationship objects 9.

As described above, when a management object 8 is detected, a rule for a device  
25 corresponding to the management object 8 and another a device directly connected thereto is applied and then dependent relationship between the two devices is generated as a relationship object 9.

FIG.7 is a diagram showing a class  
30 structure according to the present invention. At least the following information as shown in FIG.7 is registered.

- Hub class:
    - Object ID
    - Port No[ ]
    - MAC Address[ ]
  - Hub-MachineRel class:
- 35

- Object ID1
- Object ID2
- Dependency (dependent relationship)
- Machine class:
  - Object ID
  - MAC Address[ ]
  - . . .

It should be noted that the information described above is shown in FIG.7.

10                   Therefore, the class structure is used.  
Instances of the hub class and the machine class (for example, see FIG.10A and FIG.10B) are defined as the management objects 8 (for example, see FIG.10A and FIG.10B) and the instance of the Hub-MachineRel class  
15 is defined as the relationship object 9 (for example, see FIG.10C).

FIG.8 is a diagram showing a rule for generating relationship according to the present invention. The rule is used to automatically  
20 generate a relationship object 9 between a hub and a machine. The first few lines:

- CLASS 1 OF MANAGEMENT OBJECT TO BE MANAGED:  
Hub CLASS
- CLASS 2 OF MANAGEMENT OBJECT TO BE MANAGED:  
25 Machine CLASS

define a generating rule for a relationship object 9 for the Hub class and the Machine class. In the same way, another relationship object 9 for other classes is defined.

30                   A condition is defined as follows:  
• CLASS OF RELATIONSHIP OBJECT TO BE GENERATED  
WHERE A MAC Address PROPERTY FOR CLASS 1 IS THE SAME  
AS A MAC Address PROPERTY FOR CLASS 2.

35                   When the condition above is true, a Hub-MachineRel class is generated. Properties of the relationship object 9 are registered as follows:

- Dependency PROPERTY <- INSTANCE OF CLASS 2

DEPENDS ON INSTANCE OF CLASS 1

• Dependency PROPERTY <- INSTANCE OF CLASS 1  
DOES NOT INFLUENCE INSTANCE OF CLASS 2

In accordance with the rule shown in FIG.8,  
5 the relationship object 9 where the hub and the machine are mutually connected is generated. For example, the relationship object 9 shown in FIG.10C can be automatically created.

FIG.9 is a flowchart for explaining a  
10 process for additionally providing a hub according to the present invention.

In a step S41 of FIG.9, a rule for additionally provide a hub is executed.

In a step S42, a hub having the same MAC  
15 address is searched for. That is, for example, when the hub 14 in FIG.2 is additionally provided, a hub having the same MAC address as the hub 14 is searched for. In the case of FIG.2, the hub 12 indicated by the letter (a), which is above the hub 14, is found.  
20 The same MAC address as the hub 14 additionally provided is searched for from port information managed in the management object 8 of the hub 12 indicated by the arrow (a) where any one of ports is connected to the hub 14.

25 In a step S43, it is judged whether or not the hub having the same MAC address as the hub 14 is found. When it is judged that the hub having the same MAC address as the hub 14 is found (YES), the process advances to a step S44. On the other hand,  
30 when it is judged that the hub having the same MAC address as the hub 14 is not found (NO), the process is terminated since there is no hub having the same MAC address as the hub 14.

In the step S44, an instance for a hub-hub  
35 class is generated. A relationship object 9 for a dependent relationship between hubs is generated by executing steps S51 through S54.

002200 80072960

5

10

15

25

In a step S45, a machine having the same MAC address X is searched for.

In a step S46, it is judged whether or not the machine having the same MAC address X is found. When the machine is found (YES), the process advances to a step S47. On the other hand, when the machine  
5 is not found (NO), the process is terminated.

In the step S47, an instance (relationship object 9) of a hub-machine class is generated in a similar method to the steps S21 through S24 of FIG.5 (see FIG.10C).

10 As described above, when the hub 14 and the machine 15 in FIG.2 are additionally provided, based on the management objects 8 where the configuration information of the additional hub 14 and machine 15 is registered, it is possible to  
15 automatically register the dependent relationship between hubs and the dependent relationship between the hub and the machine as the relationship objects 9, respectively.

FIG.10A is a diagram showing an instance (management object 8) of a hub. In FIG.10A, the  
20 instance (management object 8) of the hub shows a registration of the configuration information described therein.

- hub ID: hub 0
- 25 • object ID: 02
- destination MAC address per port  
or its own MAC address

As described above, a function of the hub automatically registers (learns) the MAC address of a  
30 destination device (hub, router, machine or the like) to be managed per port in the management object 8 for the hub. Thus, as described in flowcharts of FIG.5 and FIG.9, it is possible to automatically determine that two devices are mutually connected when the MAC  
35 address of the destination device to be managed corresponds to that maintained in the hub. Also, it is possible to automatically generate the

FIG.10B is a diagram showing an instance (management object 8) of a machine. The configuration information is registered in the instance (management object 8) of the machine.

- As described above, the object ID and the MAC address are registered in the management object 8 of the machine. Based on the MAC address such as described in flowcharts of FIG.5 and FIG.9, it is possible to automatically determine that two devices are mutually connected when the MAC address of the device to be managed corresponds to that maintained in the destination hub. Also, it is possible to automatically generate the relationship object 9 where the dependent relationship between the two devices is registered.

```

    • hub ID: hub-machine 0
    • object ID1 (parent): 02 (object ID for a
device to be managed as a parent)
30    • object ID2 (child): 03 (object ID for a
device to be managed as a child)
    • dependence 1->2 (dependent relationship
from the parent to the child): "CRITICAL"
    • dependence 2->1 (dependent relationship
35 from the child to the parent): "NO INFLUENCE"

```

As described above, the dependent relationship from the parent to the child and the





process finds the relationship object 9 as shown in FIG.10C including information of the device (object ID), which is included in the event received in the step S61, it is determined based on the dependent relationship determined in the relationship object 9 whether or not the event for the registered management object 8 is defined in the event table 10 in FIG.12. When the event is defined, the suppress-flag is set to "ON" so that an alarm for the icon of the device corresponding to the event is suppressed. When the dependent relationship in the relationship object 9 is "CRITICAL" and another event for another device in a connection direction has been previously received and registered in the event table 10 in FIG.12, the suppress-flag is set to "ON" so as not to display the alarm. Therefore, it is possible to make an alarm based on an event extracted from all events received, which event indicates where the problem is actually caused.

FIG.12 is a diagram showing an event table according to the present invention. Every event sent from the agents 21 connected to the network is registered in the event table 10. In accordance with the flowchart in FIG.11, when an event is registered, based on the registered relationship object 9 of the management object 8 defined in the received event, the suppress-flag of the event of the management object 8 for an influenced device is set to "ON" so as not to make an alarm. On the other hand, an icon representing a device for which the suppress-flag is set to "OFF" is blinked on the main display window in FIG.2. Accordingly, only an icon representing a device actually causing a problem is blinked so that the administrator can easily realize and specify the device causing the problem.

FIG.13 is a block diagram of a hardware configuration that implements the server as the

apparatus for managing a network according to the present invention.

5 The server 1 includes a CPU 11, a memory unit 12, an output unit 13, an input unit 14, a display unit 15, a storage unit 16, a CD-ROM driver 17 and a communication unit 18 which are mutually connected by a bus B. The CPU 11 controls the entire system in accordance with a program resident in the memory unit 12. In addition, the CPU 11 executes the process for defining a relationship between two devices, the rule process for providing an additional node and for monitoring the devices that are described above. The memory unit 12 includes a ROM and a RAM. Also, the memory unit 12 temporarily stores programs, events sent from the agents 21, various data and the like during the execution of the processes. The output unit 13 includes a printer or the like. The input unit 14 includes a keyboard and a mouse for the administrator to input information into the system, for example, in order to setup the network system, but is not limited to only these input devices.

25 The display unit 15 displays the main display window, the sub-display window, results of various processes, or the like.

30 The storage unit 16 includes a hard disk unit and stores various data and programs. Also, the storage unit 16 is used for the object DB 7 and the event table 10 in FIG.1. In accordance with instructions from the CPU 11, the CD-ROM driver 17 reads information from a CD-ROM 20 set in the CD-ROM driver 17 and then provides the information to the storage unit 16. For example, various programs according to the present invention are provided by the CD-ROM 20. That is, the programs read from the CD-ROM 20 are installed in the storage unit 16 through the CD-ROM driver 17. It should be noted

002200 80072960

that a recording medium is not limited to a CD-ROM, but other computer-readable recording media such as a magnetic disk, a magnetic tape, an optical disk, a magneto optical disk, a semiconductor memory or the like may be used.

The communication unit 18 is used to receive or send information concerning events from or to the agents 21.

As described above, according to the present invention, the management object 8 for managing the information related to the devices connected to the network and the relationship object 9 for managing the dependent relationships between the devices are provided. The processes for additions and changes of the devices are dynamically executed. Moreover, the device that actually causes a problem can be specified and the alarm is displayed so as to inform the administrator that the problem is occurring at the device. Therefore, even in the distributed network system where a device configuration is dynamically changed or a device is additionally provided, it is possible to specify a device (a router, a hub, or a machine), which actually causes a problem, based on the events sent from the devices being managed and to inform the administrator of the problem on the display.

The present invention is not limited to the specifically disclosed embodiments, variations and modifications, and other variations and modifications may be made without departing from the scope of the present invention.

The present application is based on Japanese Priority Application No. 11-306365 filed on October 28, 1999, the entire contents of which are hereby incorporated by reference.

WHAT IS CLAIMED IS:

5

1. An apparatus for monitoring devices connected to a network, comprising:

10 a relationship object maintaining part maintaining dependent information for each relationship between devices connected to the network, said dependent information indicating how one device influences another device when the one device causes a problem;

15 an event table maintaining part maintaining device information, which identifies a device in the network, indicated by an event received from the device;

20 an event collecting part collecting each event received from the devices and controlling the event table maintaining part to maintain the device information when the event indicates a problem; and

25 a problem alarm notifying part determining, based on the dependent information maintained by the relationship object maintaining part, whether or not each of the devices identified by the device information maintained by the event table maintaining part influences another device by the problem, and specifying which device is causing the problem in accordance with a result of the determination.

30

35 2. The apparatus as claimed in claim 1, wherein said dependent information is defined for each of a first direction from said one device to said another device and a second direction from said

004260"80072960

5

said device information maintained by said event table maintaining part includes a suppressing flag for suppressing said problem alarm notifying part from specifying that the device corresponding to said device information is causing the problem; and

said problem alarm notifying part determines whether or not the event table maintaining part is to maintain the device information of another event received from another device indicated by the dependent information corresponding to said event received from the device, and controls a suppressing flag based on the dependent information in accordance with a result of the determination, so that said problem alarm notifying part specifying which device is causing the problem.

4. The apparatus as claimed in claim 1,  
wherein when the event received from the device  
30 indicates to change or add the dependent information,  
said event collecting part controls said relationship  
object maintaining part to change or add the  
dependent information in accordance with a  
predetermined rule for defining the dependent  
35 information based on the relationship between two  
types of the devices.









wherein when the event received from the device indicates to change or add the configuration information, said step (c) executes said step (e) to change or add the configuration information indicated  
5 by the event, and executes said step (a) to change or add the dependent information related to devices connected to the device that sent the event.

10

12. The method as claimed in claim 7, further comprising steps of:

(e) maintaining configuration information  
15 related to a configuration of each of the devices to be managed;

(f) representing each configuration information maintained in said step (e) as a clickable image on a display unit; and

(g) displaying several selectable types of  
20 the dependent information to define the dependent information between the devices corresponding to the clickable images when at least two clickable images are clicked,

25 wherein the dependent information defined in said step (g) is maintained in said step (a).

30

13. A computer-readable recording medium having a program recorded thereon for causing a computer to manage a network, comprising the codes of:

(a) maintaining dependent information for  
35 each relationship between devices connected to the network, said dependent information indicating how

004250-80072960

one device influences another device when the one device causes a problem;

(b) maintaining device information, which identifies a device in the network, indicated by an event received from the device;

(c) collecting each event received from the devices and executing the code (b) to maintain the device information when the event indicates a problem; and

(d) determining, based on the dependent information maintained by the code (a), whether or not each of the devices identified by the device information maintained by the code (b) influences another device by the problem, and specifying which device is causing the problem in accordance with a result of the determination.

14. The computer-readable recording medium as claimed in claim 13, wherein said dependent information is defined for each of a first direction from said one device to said another device and from a second direction said another device to said one device by dependent information between the devices.

15. The computer-readable recording medium as claimed in claim 13, wherein:  
said device information maintained by said code (b) includes a suppressing flag for suppressing from specifying that the device corresponding to said device information is causing the problem; and  
said code (d) determines whether or not

5

15

15

25

30

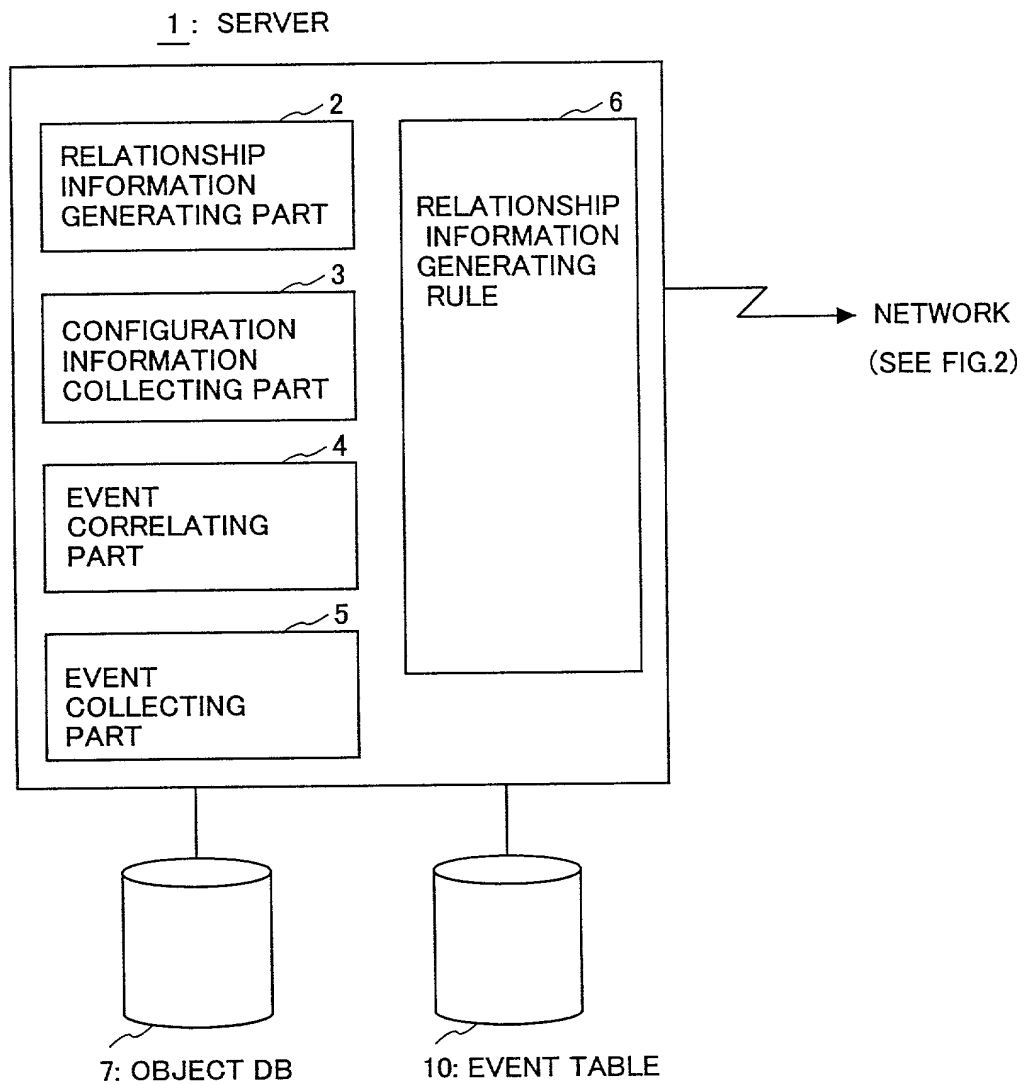
35



In an apparatus for monitoring devices connected to a network, an event collecting part collects each event received from the devices and controls an event table to maintain device information when the event indicates a problem. A problem alarm notifying part determines, based on dependent information maintained by a relationship object maintaining part, whether or not each of the devices identified by the device information maintained in the event table influences another device by the problem, and specifies which device is causing the problem in accordance with a result of the determination.

5  
10

FIG.1



- MANAGEMENT OBJECTS 8
- RELATIONSHIP OBJECTS 9









FIG.5

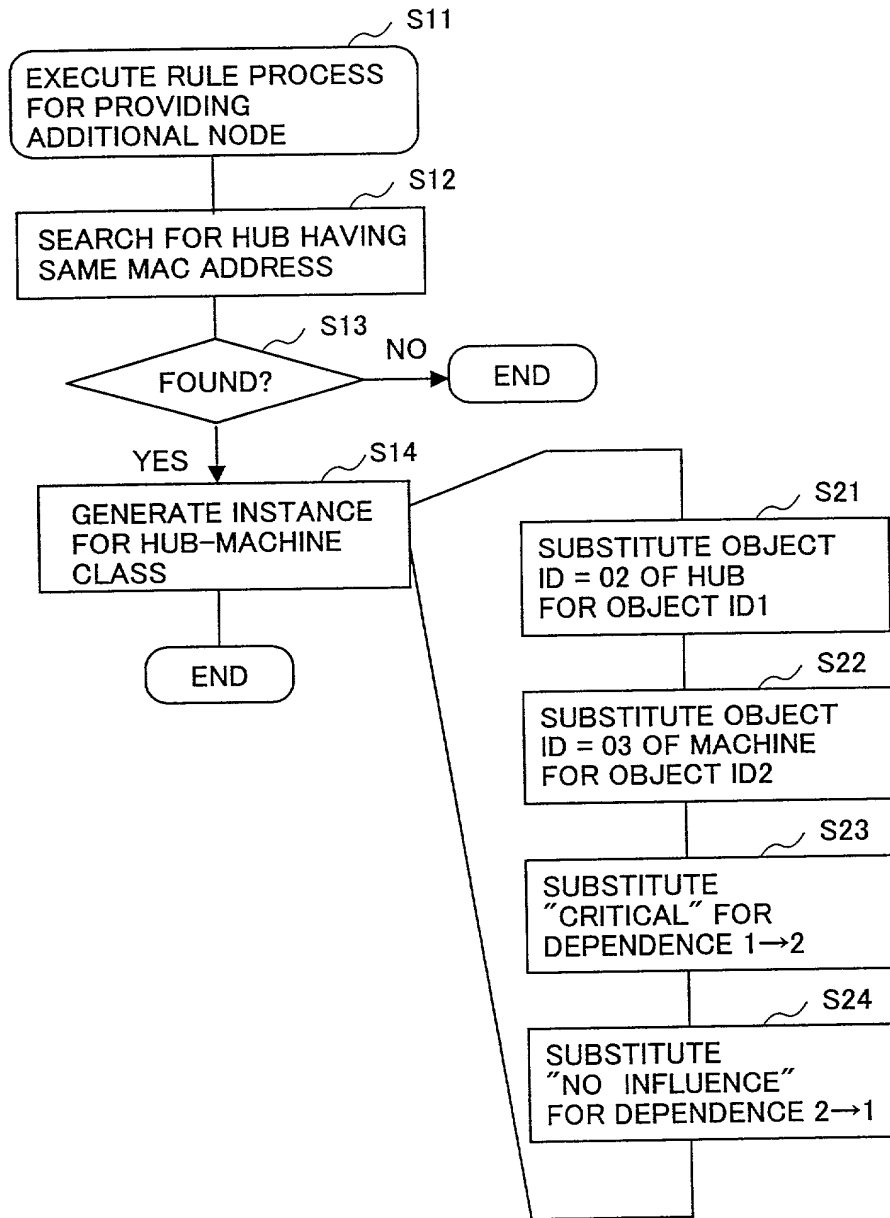
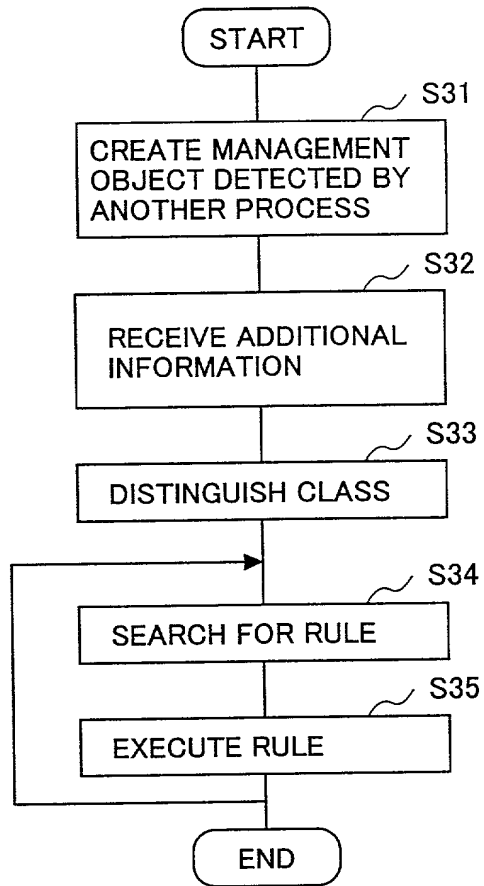
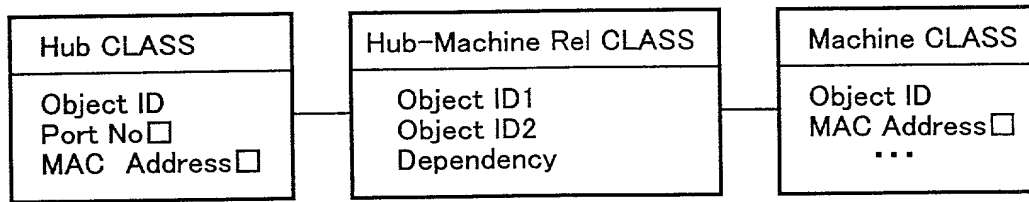


FIG.6



## FIG.7



Hub CLASS : INDICATE HUB

Machine CLASS : INDICATE MACHINE

Hub-Machine Rel CLASS : INDICATE RELATIONSHIP BETWEEN INSTANCE OF MACHINE CLASS

Object ID : ID IDENTIFYING INSTANCE OF CLASS

Port No : EACH PORT NUMBER OF HUB (ARRAY)

MAC Address : PORT OF HUB AND MAC ADDRESS FOR INTERFACE OF MACHINE

Object ID1/2 : INSTANCE ID RELATED BY Hub-Machine Rel CLASS

Dependency : DEPENDENT RELATIONSHIP OF INSTANCE RELATED BY Hub-Machine Rel CLASS

## FIG.8

### RULE 1 {

CLASS1 OF MANAGEMENT OBJECT TO BE MANAGED:

Hub CLASS

CLASS2 OF MANAGEMENT OBJECT TO BE MANAGED:

Machine CLASS

CONDITION:

CLASS OF RELATIONSHIP OBJECT TO BE GENERATED WHERE  
MAC Address PROPERTY FOR CLASS1 IS SAME AS MAC Address  
PROPERTY FOR CLASS 2

CLASS OF RELATIONSHIP OBJECT TO BE GENERATED:

Hub-Machine Rel CLASS

PROPERTY OF RELATIONSHIP OBJECT TO BE GENERATED:

Dependency PROPERTY ← INSTANCE OF CLASS 2 DEPENDS ON  
INSTANCE OF CLASS 1

Dependency PROPERTY ← INSTANCE OF CLASS 1 DOES NOT  
INFLUENCE INSTANCE OF CLASS 2

FIG.9

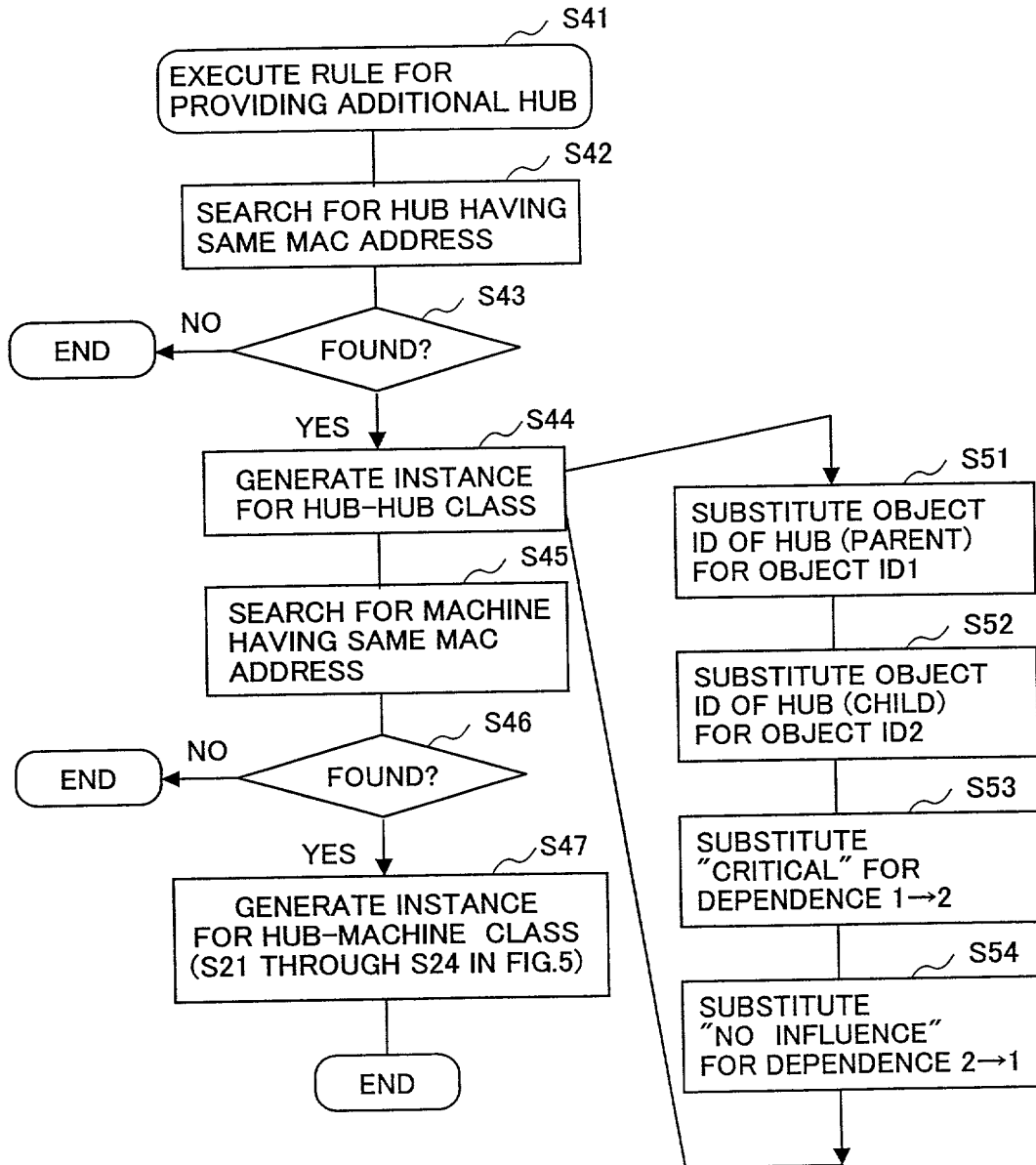


FIG.10A

HUB ID	OBJECT ID	MAC ADDRESS CONNECTED TO PORT		OWN MAC ADDRESS	
HUB0	02	0	MAC 100		
		1	MAC101	10	
			.		
			.		
			.		
			.		

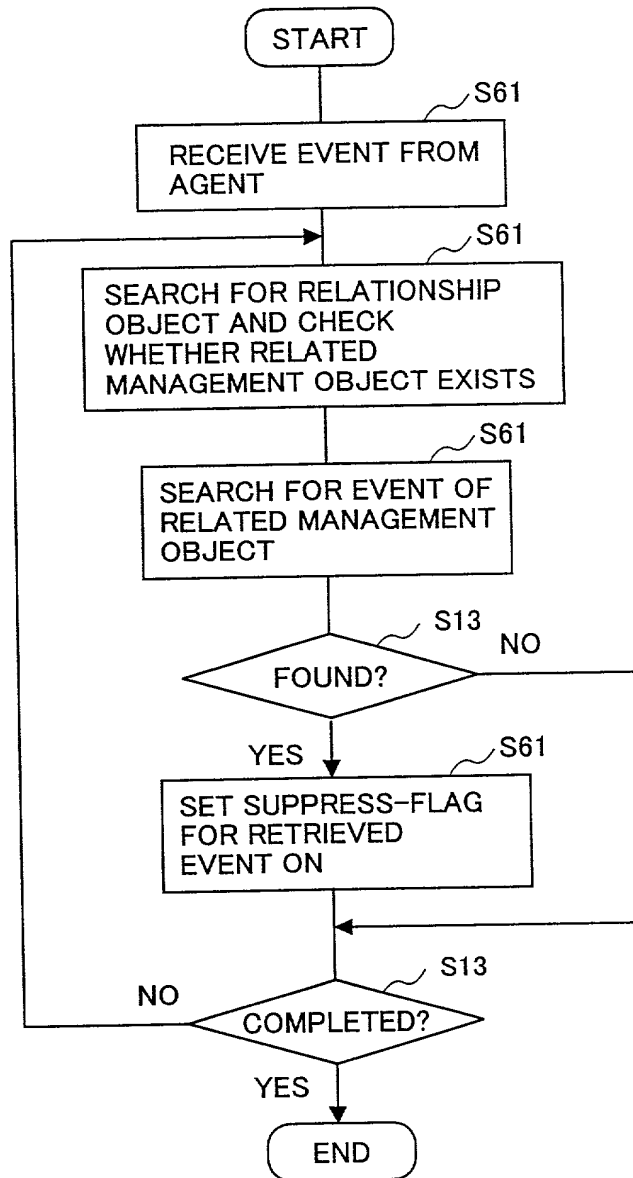
FIG.10B

MACHINE ID	OBJECT ID	MAC ADDRESS	
MACHINE	03	MAC 1	

FIG.10C

HUB-MACHINE ID	OBJECT ID1	OBJECT ID2	DEPENDENCE 1 → 2	DEPENDENCE 2 → 1
HUB-MACHINE	02 (PARENT)	03 (CHILD)	CRITICAL	NO INFLUENCE

FIG.11



09624008-09200

FIG.12

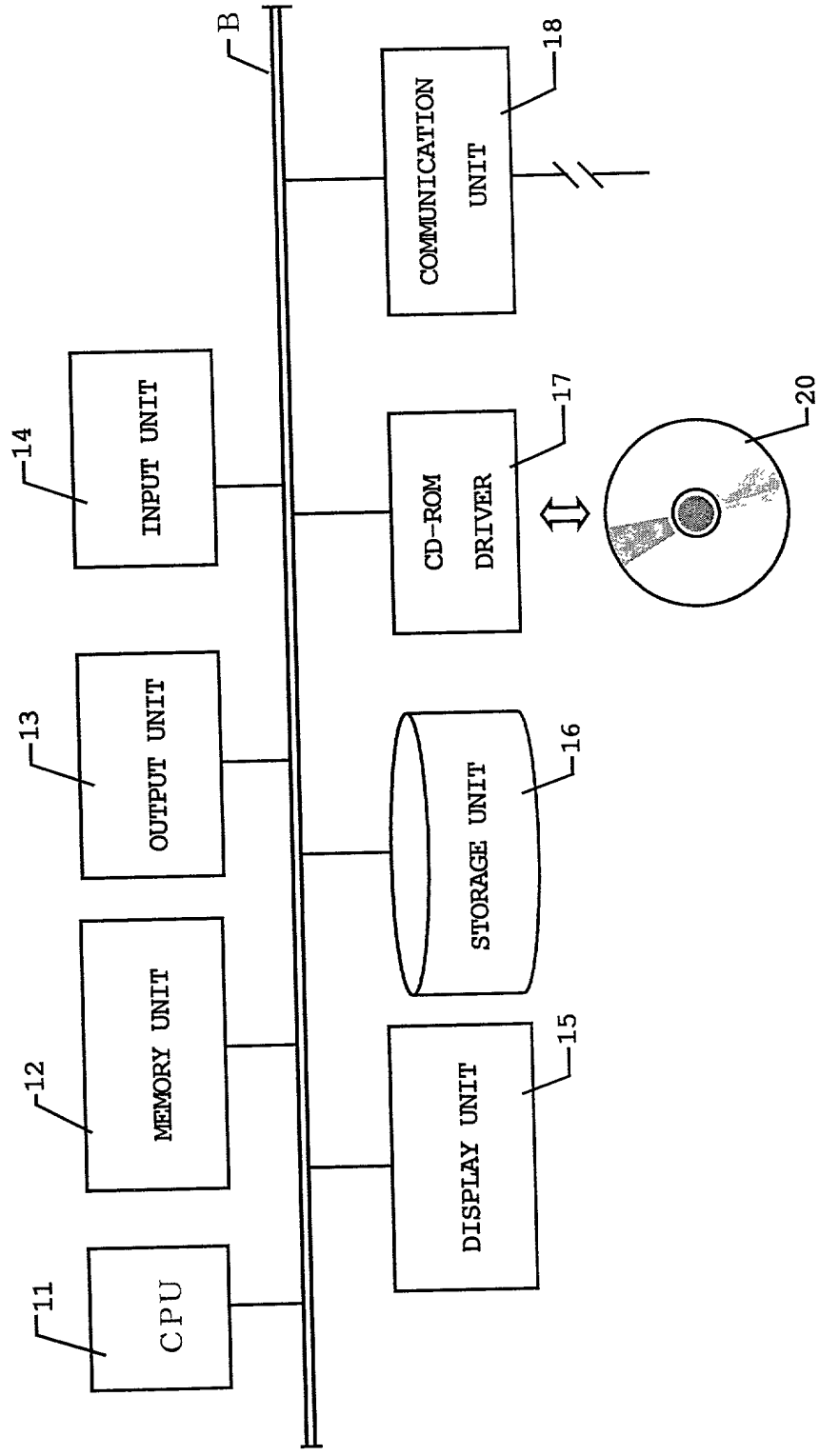
10

EVENT ID	OBJECT ID	SUPPRESSION STATUS (SUPPRESS-FLAG)	
00	HUB ID	OFF	
01	MACHINE ID	ON	
		(・DEGRADE CRITICAL LEVEL)	

004260" 80072960



FIG. 13



Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## Declaration and Power of Attorney For Patent Application

## 特許出願宣言書及び委任状

## Japanese Language Declaration

## 日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

---

 APPARATUS AND METHOD FOR MANAGING  
 NETWORK AND COMPUTER-READABLE  
 RECORDING MEDIUM THEREOF
 

---

上記発明の明細書（下記の欄でx印がついていない場合は、本書に添付）は、

the specification of which is attached hereto unless the following box is checked:

☐ 月 日に提出され、米国出願番号または特許協定条約国際出願番号を \_\_\_\_\_ とし、  
 （該当する場合） \_\_\_\_\_ に訂正されました。

☐ was filed on \_\_\_\_\_  
 as United States Application Number or  
 PCT International Application Number  
 \_\_\_\_\_ and was amended on  
 \_\_\_\_\_ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Japanese Language Declaration  
(日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基づき下記の、米国外の国の少なくとも一カ国を指定している特許協力条約365(a)項に基づき国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張して、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

## Prior Foreign Application(s)

外国での先行出願 Pat. Appln. No. 11-306365	Japan
(Number) (番号)	(Country) (国名)
_____	_____
(Number) (番号)	(Country) (国名)
_____	_____

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

## Priority Not Claimed

優先権主張なし

28/October/1999

(Day/Month/Year Filed)

(出願年月日)

☐

(Day/Month/Year Filed)

(出願年月日)

☐

私は、第35編米国法典119条(e)項に基づいて下記の米国外特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.)

(出願番号)

(Filing Date)

(出願日)

(Application No.)

(出願番号)

(Filing Date)

(出願日)

私は、下記の米国法典第35編120条に基づいて下記の特許出願に記載された権利、又は米国を指定している特許協力条約365条(c)に基づき権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.)

(出願番号)

(Filing Date)

(出願日)

(Status: Patented, Pending, Abandoned)

(現況: 特許許可済、係属中、放棄済)

(Application No.)

(出願番号)

(Filing Date)

(出願日)

(Status: Patented, Pending, Abandoned)

(現況: 特許許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じることに基づき表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Japanese Language Declaration (日本語宣言書)

委任状: 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。(弁理士、または代理人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

<u>Attorney</u>	<u>Reg. No.</u>
Patrick G. Burns	29,367
Roger D. Greer	26,174
Lawrence J. Crain	31,497
Steven P. Fallon	35,132

<u>Attorney</u>	<u>Reg. No.</u>
James K. Folker	37,538
Jonathan D. Feuchtwang	41,017
B. Joe Kim	41,895
Joel H. Bootzin	42,343

直接電話連絡先: (名前及び電話番号)

Send Correspondence to:

Direct Telephone Calls to: (name and telephone number)

Patrick G. Burns, Esq.  
Greer, Burns & Crain, Ltd.  
Sears Tower - Suite 8660  
Chicago, IL 60606 (312) 993-0080

唯一または第一発明者名		Full name of sole or first inventor	
		Akira Tsuneya	
発明者の署名	日付	Inventor's signature	Date
		Akira Tsuneya	September 13, 2000
住所		Residence	
		Kawasaki, Japan	
国籍		Citizenship	
		Japan	
私書箱		Post Office Address	
		c/o FUJITSU LIMITED, 1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki-shi, Kanagawa, 211-8588 Japan	
第二共同発明者		Full name of second joint inventor, if any	
		Masato Nitta	
第二共同発明者	日付	Second inventor's signature	Date
		Masato Nitta	September 13, 2000
住所		Residence	
		Kawasaki, Japan	
国籍		Citizenship	
		Japan	
私書箱		Post Office Address	
		c/o FUJITSU LIMITED, 1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki-shi, Kanagawa, 211-8588 Japan	

(第三以降の共同発明者についても同様に記載し、署名をすること)

(Supply similar information and signature for third and subsequent joint inventors.)